Non-Seperating Ski/Blade/Board Safety Binding for Limiting Torque on the Lower Leg and Having Multi-positional Capabilities

U.S. Patent Application of:

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"Express mail" mailing label number

EU606924230US

Date of Deposit: 7/21/03

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Title of the Invention

Non-Seperating Ski/Blade/Board Safety Binding for Limiting Torque on the Lower Leg and Having Multi-positional Capabilities

Cross Reference to Related Applications

This application is based on provisional application serial number 60/397,560, filed on July 19, 2002.

Statement Regarding Federally Sponsored Research or Development

Not Applicable

Description of Attached Appendix

Not Applicable

Background of the Invention

This invention relates generally to the field of snowsports and more specifically to non-Seperating Ski/Blade/Board Safety Binding for Limiting Torque on the Lower Leg and Having Multi-positional Capabilities.

For more than four decades safety ski bindings have been available that can help protect the leg from twist related injuries. All of these bindings are designed to release the boot from the binding, so the ski separates from the skier, except perhaps for some retention cable or strap. This kind of separation can prevent potentially injurious

torques from being transmitted from the ski to the leg, however it also introduces potential problems.

Many bindings release in what is commonly known as "twist" to protect the leg from potentially injurious torques from being transmitted from the ski to the leg. The twist release results in separation of the boot from the ski. Twist release occurs after the boot has been displaced rotationally about an axis perpendicular to the plane of the ski, an axis that is approximately coincident with the axis of the skier's tibia. The amount of rotation of the boot relative to the ski before twist release depends on the binding mechanism, and varies from a few degrees to just less than 20 degrees in most cases. The maximum torque required to effect this displacement for twist release under quasi-static conditions is adjustable. It can be regulated for the purpose of retaining the skier in normal skiing maneuvers, according to national and international standards, using the skier's weight and skiing type as the essential parameters. The assumption is that the maximum torque that a skier needs to apply to the skis throught the boot binding interface that are required for normal skiing maneuvers are based on the skier's weight and skiing type, and that this torque is less than the torque for causing a torsional type injury to the skier's leg. The intent is that the binding should keep the ski attached to the boot for normal skiing, and release when injury is impending, thereby avoiding the injury.

The binding mechanism defines the relationship between the rotational displacement of the boot relative to the ski and the torque used to effect that displacement under quasi-static conditions. Generally the mechanism is designed so that the torque-displacement curve is steep initially, in that relatively large increases in torque are required to cause relatively small increases in displacement, then there is a

less steep portion on the curve, where the torques increase only slightly with relatively large displacements, finally there may be increasing displacement with decreasing torque and eventually enough displacement to cause release. If the torque causing the displacement is removed before release the boot should return to its original, non-loaded position, aligned with the longitudinal axis of the ski. With this kind of behavior bindings can have some capacity to adsorb torsion shocks. That is the boot can be displaced rotationally relative to the ski dynamically and, once the torque that caused that displacement is removed, the binding then returns the boot to the center of the ski once again.

Unfortunately conventional bindings are known to release inadvertently, that is during normal skiing when injury is not impending. This happens when the rotational displacement limit is reached, without danger of injury. When this happens the skier is left without a ski, consequently often out of control, and sometimes going at a high rate of speed. Because the out-of-control skier can collide with a tree or other obstacles, inadvertent release is a situation where many of the most serious injuries and deaths occur in skiing.

The events leading to an inadvertent release in torsion can result from certain shaped and sized geometrical features on the snow surface that displace the ski rotationally, and from excessive friction in the boot binding interface that inhibits the binding from re-centering the boot relative to the ski after a torque has been removed so that a relatively small subsequent torque in the same direction will result in release, i.e., the effect of rotational shocks can become at least partially cumulative, and inadvertent release can result from unusually vigorous muscular activity as might be used in recovering from a disequilibrating event. These kinds of events have the potential to

rotationally displace the boot far enough so that it escapes from the binding and the skier loses the ski and loses control. Any binding that releases the boot from the ski by complete separation after a certain amount of rotational displacement is susceptible to inadvertent releases.

In the late 1990s short skis (usually less then 1m long and sometimes called skiblades, skiboards or snowblades) were successfully re-introduced to the market after a couple of decades of relative absence. Many manufacturers are providing these short skis with non-releasable bindings. This inability to release has resulted in an injury rate of twist related injuries on these short skis that is several times the injury rate on normal skis with release bindings. Another feature is that many of these short skis are designed with a tip at either end, i.e., they can be skied equally well forwards or backwards.

Snowboards generally have safety bindings or have bindings that allow the foot to rotate to prefixed positions relative to the board with out the rider reaching down to adjust something. This causes two problems. One is for injuries. The other is awkwardness while riding the lift or pushing along a flat.

Lower leg injuries on snowboards are relatively rare. When both feet are fixed to the board, as they usually are, the legs act to protect each other. However when one foot is disengaged the other leg is at considerable risk to serious injury. One foot is frequently disengaged while riding the lift. Some of the most serious knee injuries seen in injury studies at ski areas have occurred to snowboarders while unloading the lift with only one foot engaged in binding that firmly attaches the boot to the board, with no means of release or of filtering out potentially injurious torques.

Snowboard riders usually have their feet attached to the board at a significant angle to the central, or longitudinal, axis of the board. This is intended for riding down the hill, when the rider would like to be facing significantly sideways relative to the direction of motion, and longitudinal axis of the board. When one foot is removed to push, or to facilitate riding the lift, then the rider would like the foot that is still attached to be facing in the same direction as the longitudinal axis of the board. In these situations the remaining foot is still fixed by the binding at a significant angle to the longitudinal axis, and there is no simple means of changing the orientation of the foot on the board, without at least reaching down to the board, and maybe removing the foot and using a tool.

Many safety bindings require devices mounted on the ski, blade or board, that are positioned in front of the boot toe, or behind the boot heel. These devices, combined with the boot that they are designed to hold, can have an adverse influence on the flex pattern of the ski, blade of snowboard, or their size and position put minimum size constraints on the design of the board or short ski. Plates have been designed to limit the influence of these kinds of devices on the flex pattern of what they are mounted on. There are also safety bindings designed to limit the torque that can be transmitted to the leg, or position the boot on a snowboard, that attach to the ski, blade or board so that they reduce their influence on the flex pattern.

Many safety bindings for skis, blades and boards combine release modes, in that the mechanisms that control release, or protection of the leg in rotation, i.e., torsion, are combined and coupled with those that protect the lower leg from injury in forward or backward bending or roll about the longitudinal axis of the ski. In this way it is can be

difficult for binding designers to modify the mechanics of one of these modes of release, or protection, without influencing the other.

There are examples of safety bindings devices that can be used on long or short skis (short skis are also called blades, ski blades, ski boards or snow blades) or snowboards that mount under the boot and thereby have a reduced influence on the flex pattern of the ski or board, but all of them protect the leg from potentially injurious loads by separating the ski blade or board completely from the foot on release. US patents 3,918,732, Safety Binding for Skis, 4,196,920, Safety Ski Binding, and 4,185,851, Pivoting Safety Binding for Skis, show a pivotal, or rotational, devices under the boot with cam surfaces. These devices do not allow for multiple selected, rotational positions for skiing or riding and, on release, in order to protect the leg from potentially injurious loading they cause a complete separation of the boot from the ski.

There are examples of bindings for snowboards that can position the foot rotationally relative to the board, but repositioning these requires activation of a lever or set screw or some other device by the board rider. US patent 5,028,068, Quick-action adjustable snow boot binding mounting allows for adjustment of the rotational orientation, but requires the rider to reach down and activate a lever in order to change the adjustment. US patent 5,044,654, Plate Release Binding Winter Sports Device, provides mechanisms for release and adjustment of direction, but contains potentially unnecessary modes of release, and requires the rider to remove the boot from the binding and use a tool to adjust the rotational position of the binding. US patents 5, 236,216, Binding for Snowboards, and 5,586,779 Adjustable Snowboard Boot Binding Apparatus, allow for adjustment of the rotational position, but have no safety or protection function, and they require removal of the boot and a wrench or adjustment

tool to change the rotational position of the boot on the board. US patent 5,553,883 Snowboard Binding which Permits Angular Reorientation of a User's Foot while Maintaining that Foot Attached to the Snowboard, allows for adjusting the rotational position of the boot, but has no safety function and the rider has to reach down to make the adjustment. US patent 5,826,910, Swivelable Snowboard Bindings, requires the rider to reach down and remove and insert a pin to adjust the rotational position. US patent 5,855,390, Laterally Flexible Binding System, requires an adjustment tool to change the alignment, or rotational position. US patents 4,964,649, Snowboard Boot Binder Attachments and 6,491,310 Free Swiveling Mount for Sliding Board Boot Bindings, allow free rotation for changing the rotational position, while riding, without a tool, however they use a spring rather than a cam-follower to bias the rotational position which only works for one position, so there is no means of locking the boot into multiple, stable, pre-selected rotational positions relative to the board, without using a tool. US patent 6,279,924 B1, Snowboard Safety Release Binding, protects the leg from potentially injurious loads but does it by separating the boot from the board.

There are bindings especially for short skis (also called skiblades, skiboards or snowblades) that do not have release functions. US patent 6,315,318 B1 shows a binding especially for a skiboard, that has no means of protecting the leg from potentially injurious torques.

Current safety bindings for skis, blades and boards fail to decouple release modes, so that the release mechanism in forward lean can interfere with the release in rotation, or torsion, which is the object of this invention.

Current safety bindings for skis, blades and boards feature a complete separation to protect the lower leg from potentially injurious torques, and are therefore subject to inadvertent release.

Current safety bindings for snowboards cannot position the boot rotationally to pre-selected positions on the ski or board without the use of a tool, or having the rider reach to activate a lever, while protecting the leg from potentially injurious torques.

For sufficiently skis that are sufficiently short, a.k.a. skiblades and skiborads, and for snowboards, by and large the only loads that are transmitted through the boot binding interface to the leg and have the potential to produce injury are rotational, i.e., twist, type loads, as opposed to forward or backward bending or left or right lateral roll. Any safety binding that includes these extra release modes unnecessarily are therefore unnecessarily complicated and unnecessarily expose the user to inadvertent release in these other modes.

Brief Summary of the Invention

The primary object of the invention is to provide a ski-boot, snowboard-boot, snowblade-boot connection that does not require re-attachment or re-centering after protecting the leg from a twist related injury.

Another object of the invention is to eliminate inadvertent release in twist.

Another object of the invention is to provide a torque limiting binding for skis, blades, and boards that can move from different stable positions for using lifts and riding downhill by simply twisting the foot, without having to reach down or use a tool.

A further object of the invention is to provide a means for mechanically decoupling the protection mechanism for the leg in twist from other release mechanisms.

Yet another object of the invention is to provide a means for reversing the direction of the user on two-tipped skis, snowblades, or snowboards without removing the boot or the use of any tools.

Still yet another object of the invention is to eliminate the effect of any kind of contamination in the boot-binding interface on the binding performance in twist.

Another object of the invention is to reduce the influence of the boot-binding system on the flex of the ski, blade, or board.

Other objects and advantages of the present invention will become apparent from the following descriptions, taken in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed.

In accordance with a preferred embodiment of the invention, there is disclosed Non-Seperating Ski/Blade/Board Safety Binding for Limiting Torque on the Lower Leg and Having Multi-positional Capabilities comprising: a 360 degree cam surface allowing full rotation of the ski, board or blade relative to the boot, at least one cam follower with spring and tensioner to regulate the ski-ability or injury torque threshold, the cam is shaped to provide stable positions where desired for normal skiing, the cam is shaped

to provide torque rotation properties to provide for control of the ski, board or blade, and the cam is shaped to allow rotation below the desired threshold for injury or ski-ability.

Brief Description of the Drawings

The drawings constitute a part of this specification and include exemplary embodiments to the invention, which may be embodied in various forms. It is to be understood that in some instances various aspects of the invention may be shown exaggerated or enlarged to facilitate an understanding of the invention.

Figure 1 is a side elevation of a first embodiment of a binding according to the invention, with the ski fitted.

Figure 2 is a plan view of the binding illustrated in Fig 1, in the position in which a torque would be removed or filtered from the leg with the boot removed.

Figure 3 is a plan view of the binding illustrated in Fig 1, in the position for normal use with the boot removed.

Figure 4 is a side cross sectional view along line A-A in Fig 3.

Figure 5 is a side elevation of the binding illustrated in Fig 1, in the position for normal use with the boot removed.

Figure 6 is a top cross sectional view along line B-B in Fig 5.

Figure 7 is a side elevation of a second embodiment of a binding according to the invention, with the ski fitted.

Figure 8 is a plan view of the binding illustrated in Fig 7, in the position in which a torque would be removed or filtered from the leg with the boot removed.

Figure 9 is a plan view of the binding illustrated in Fig 7, in the position for normal use with the boot removed.

Figure 10 is a side cross sectional view along line C-C in Fig 9.

Figure 11 is a side elevation of the binding illustrated in Fig 7, in the position for normal use with the boot removed.

Figure 12 is a top cross sectional view along line D-D in Fig 11.

Detailed Description of the Preferred Embodiments

Detailed descriptions of the preferred embodiment are provided herein. It is to be understood, however, that the present invention may be embodied in various forms. Therefore, specific details disclosed herein are not to be interpreted as limiting, but rather as a basis for the claims and as a representative basis for teaching one skilled in the art to employ the present invention in virtually any appropriately detailed system, structure, or manner.

Turning now to the drawings, it is seen that the examples illustrated are comprise of a cam, attached to the ski or the boot, and a follower mechanism. The rotary filter occurring when the torque applied to the boot from the ski, blade or board exceeds the selected, adjustable torque threshold. Filtering or relief of an applied torque is achieved when the torque threshold is exceeded and the followers pivot around the center of the cam following the cam surface. This filter is intended only to relieve the torque felt by the leg and does not allow for a separation between the ski, blade, or board and the boot.

In the embodiment illustrated in Figs. 1 to 6, the boot is attached to the cam followers and the cam is attached to the ski, blade, or board. This embodiment uses two followers **33** & **34** located along a common longitudinal axis. The followers are held in contact with the cam **28** with springs **29a** & **30a**, which are guided by channels **29** & **30**. Setscrews **31** & **32** are used to adjust the tension of springs **29a** & **30a**. Cam **28** is attached to the ski, blade, or board using a plate **27**, which is fixed to the ski, blade, or board on a longitudinal axis. The boot is fastened to the follower mechanism by using a

conventional toe and heal strap binding **21** & **21a**, which does not allow for a safety release. Binding **21** is then attached to a plate **26**, which also acts to seal the cam and follower mechanism from the elements. The cam and follower mechanism is housed inside block **25**. The cam **28** in the embodiment is designed with an elliptiodal shape to allow the binding to be automatically realigned after filtering a torque. Relief of applied torques is achieved when the torque threshold is exceeded and the followers pivot around the center of the cam following the cam surface.

The second embodiment, illustrated in Figs. 7 to 12, is a variant in which the boot is attached to the cam follower and the cam is attached to the ski, blade, or board. This embodiment also uses a single cam follower, but could use more. The follower **45**, spring **44a**, and tensioning bolt **43** and nut **43a** are all housed inside a disk **42**. This disk is attached to the top plate **47**. The binding **21** is attached to the top plate and secures the boot to the mechanism. The base plate **40** attaches to the ski, blade, or board and houses the disk **42**. Fig. 12 shows the cam surface **48**, which is machined into the base plate **40**. The adjustment hole **46** is also machined into the base plate, allowing the user to adjust the tension on the spring.

These embodiments could all use either a single or multiple follower configuration and have either the follower or cam attached to the ski. Also, the followers could be designed to allow the tensioning springs to be oriented perpendicular to the longitudinal axis of the binding, possibly allowing for a more compact mechanism. The cam profiles can be modified to produce different desired outputs, reducing or increasing the threshold torques. Multiple locking positions are also possible, i.e. allowing the binding to lock at 45 and/or 180 degrees, or some other angle to adapt to skier or rider preferences and anatomical diffrerences (duck or pidgeon toed). This

could allow for users to spin around while riding for trick purposes, or allow boarders to load and unload ski lifts facing forwards.

While the invention has been described in connection with a preferred embodiment, it is not intended to limit the scope of the invention to the particular form set forth, but on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the appended claims.